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ABSTRACT

To the casual observer, it seems improbable that human beings could produce a global environmental change. However, collective human activities have taxed the Earth's recuperative powers to their limit. The conflict of a global economy and the ecological support system make it difficult to change current conditions. Students should be made aware that there are actions they can take that will slow the rate of environmental decay. This publication is designed to provide teachers with sources of information to teach about air pollution. Two brief articles discuss greenhouse gasses, chlorofluorocarbons, climate change, and air quality. Resources listed include: (1) 61 organizations; (2) 80 journal articles; (3) 27 pamphlets; (4) 38 books; (5) 9 media materials; and (6) 2 software packages. (CW)

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AIR POLLUTION

Education and Greenhouse Gas Pollution

Richard Golden

Climate Protection Institute

It has been said that the greatest contributions of the U.S. space program to American education are the photographs of our planet from space. Where there is an experience combining the emotions and the intellect, there is an opportunity for long lasting learning. The lonely beauty of our Earth shining in the blackness is an image which can provide that opportunity.

The swirling whiteness of our cloud cover, the deep blue of our oceans, and the rich brown color of land areas evoke a poetic response. The knowledge that this speck in the cosmos shelters multitudes of living forms of marvelous complexity and that the whole sustem is intimately inter connected makes the beauty of it meaningful.

What are the works of humankind from this perspective? Our physical presence is invisible, and yet a scientific observer could detect our existence on Earth and the contamination we have poured into the atmosphere of our birthplace. This is one way to begin the study of air pollution and of human-induced climate change.

To the casual observer it seems improbable that human beings can effect a global change; the planet is so vast in comparison to our efforts. However, we are learning to our sorrow that our collective activities have taxed the Earth's recuperative powers to their limit. The facts show that the concentration of carbon dioxide, the major contributor to global warming, has been increasing since the fossil fuel era began. The natural balance of the carbon cycle which has kept our planet comfortable for life for millions of years is being upset by the industrial lifestyle of society. Our factories, fossil fuel fired energy generating plants, our furnaces and our cars and trucks are

(continued on page 3)

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FROM THE EDITOR:

When any publication such as this is being assembled, there are always innumerable people who deserve a great deal of credit. In the case of this one there were some that went far beyond the usual contribution. The first of these is Richard Golden of the Climate Protection Institute. He sent not only his excellent article, but also a bibliography, several papers and copies of their *Greenhouse Gas-etter*.

Karen Coulter, Acid Rain/Atmosphere Campaign Coordinator of Greenpeace also deserves thanks as she went out of her way to assemble an enormous package of materials.

Lani Sinclair of STAPPA/ALAPCO sent a list of organizations and other valuable materials, while Rose Marie Audette of Environmental Action also sent valuable information.

There were many others, too numerable to list individually, but to each and everyone, I offer heartfelt thanks. Without your contributions, this publication would not have been possible.

Nancy S. Van Vranken,
Editor

SCIENTIFIC LITERACY ON AIR QUALITY

The 27 Jun 88 issue of *The Scientist* described in our fall 1988 issue notes that neither 1988 presidential candidate has received visible science advice. When it comes to vital issues concerning our air quality, this has shown itself to be unfortunately true. In a published statement entitled "An Energy Policy for Growth, Security, and a Clean Environment," Governor Dukakis suggests that the greenhouse effect problem can be resolved by scrubbers on coal burning power plants. And in the debate between vice presidential candidates, Senator Quayle referred to "the impact of CO_2 to the ozone layer." While it is heartening to see these issues addressed in the campaign, it would be even more heartening to see them addressed accurately. If there wre ever an occasion to clamor for scientific literacy, this is it.

- John L. Roeder

THE TEACHERS CLEARINGHOUSE FOR SCIENCE AND SOCIETY EDUCATION, INC., is a not-for-profit organization which was founded on 11 March, 1982 by Irma S. Jarcho, John L. Roeder and Nancy S. Van Vranken. Its purpose is to channel information on resources available on scientific and technological issues having an impact upon society. The organization maintains files, open by appointment, at the New Walden Lincoln School, 210 East 77th Street, New York, NY 10021. It publishes a Newsletter three times a year. It also publishes each year, a supplement dedicated to a single topic of current interest. These services are offered free to all those who request them. Funding for The Clearinghouse comes from individual donations and grants from The Weezie Foundation and the Sanford C. Bernstein Foundation.

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Greenhouse Gases : *(continued from page 1.)*

are using the Earth's atmosphere as a dumping ground for their gaseous wastes. The result will be a rate of change of global climate unprecedented in the history of the Earth with global temperatures reaching heights unknown to human experience.

A major function of Science and Society Education is to associate concepts in science with significant social changes and issues. No subject is more suitable to make this connection than the impact of industrialism on our environment. No aspect of that impact is as important to the future of our studnets as the threat of global climate change.

Two great systems are in conflict: our global economy, based on fossil fuel energy use, and the Earth's ecological support system. If this conflict is not resolved the consequences will be globally inevitable, albeit locally unpredictable . Most important is the effect on food supply of the changed rainfall patterns that will result from global climate change. Water resources are threatened. Current irrigation and river transportation systems may be useless. Ocean currents will shift due to higher temperatures in the polar regions, bringing a change in fish reproduction. Sea level rise will destroy wetlands and contaminate coastal aquifers.

The whole topic of ecosystem response to an unprecedented rate of environmental change is filled with uncertainties. As habitats warm, species will not have time to adapt. Urban development may prevent their migration. We may be the cause of mass extinctions. Forests, already stressed by acid rain, may find the increase in temperature with its concurrent increase in pests and disease organisms too much to handle. Increaed temperature can cause human stress as well.

Teaching on this topic must be more tha prophesying doom. Students should be made aware that there are actions that they can take that will slow the rate of global warming by reducing the emission of greenhouse gases. A positive societal response can be sparked by student concern.

* First, and most cost effective are the conservation of energy and increase in the efficiency of energy use.

* Reduction in automobile use and purchase of high MPG cars will reduce emissions of carbon dioxide and nitrous oxides.

* Campaigns against products using chlorofluorocarbons have been effective.

* Development of alternative sources of energy needs public support

* The recycling process uses less energy than original manufacturing and is therefore a means of reducing fossil fuel use.

* Preventing deforestation, promoting reforestation and the planting of shade trees will help reduce carbon dioxide.

To save the world from the results of greenhouse gas pollution or our atmosphere may require the restructuring of our way of life. In the center of the mitigating effects necessary will be the students who are in our classes today. All their lives they will be struggling with a problem produced ,in large part, by our generation. The least that we can do is to provide them with the information and understanding that will help them cope with the problem.

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Note:

Richard Golden has recently retired from his position as Elementary Science Facilitator for New Rochelle, N.Y. He now coordinates the Educators' Network of the Climate Protection Institute and works with curriculum developers at the Lawrence Hall of Science, U. ofC-Berkley and at the Department of Energy on educational materials concerning global warming.

ORGANIZATIONS

Acid Rain Foundation
1410 Varsity Drive
Raleigh NC, 27606
(919) 828-9443

Acid Rain Information Clearinghouse
33 S. Washington St.
Rochester NY 14608

Action on Smoking and Health
2013 H. St. NW
Washington, DC20006
(202) 659-4310

Air and Radiation Division, EPA
401 M St., NW
Washington DC 20406

Air Pollution Control Assoc.
PO Box 2861
Pittsburgh PA 15230

Air/Water Pollution Report
951 Pershing Drive
Silver Spring MD 20910
212-587-6300

Alliance for Environmental Educ. Inc.
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American Cancer Society
19 West 56th St
New York, NY 10019

American Chemical Society
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1516 P ST., NW
Washington DC 20005

Am. Inst. of Biological Sciences
730 11th St., NW
Washington DC 20001-4584

American Lung Association
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New York NY 10019
(212) 315-8700

American Nuclear Society
Services Department
555 North Kensington, Ave.
La Grange Park, IL 60625

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Washington DC 20036

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2501 M St. NW
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Citizen's Clearinghouse for Hazardous Wastes
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Climate Protection Institute
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Environmental Action, Inc.
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Washington DC 20036

Environmental Task Force
1012 14th St., NW
Washington DC 20005

Environment Canada
Atmospheric Environment Centre
Canadian Climate Centre
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Downsview, Ontario M3H 5T4
(416) 667-4525

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Washington, DC 20036
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EPA Office of Private and Public Sector Liason
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Washington, DC 20460

ORGANIZATIONS

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Washington, DC 20003
(202) 543-4312

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Arlington VA 22209

League of Women Voters
1730 M St., NW
Washington DC 20036

National Acid Precipitation Assessment Program
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Washington DC 20503

North American Assoc. for Environmental Educ.
PO Box 400
Troy NY 45373

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950 Third Ave.
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Washington DC 2000136

The Keystone Center
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Keystone CO 80435

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1889 F. St., NW
Washington DC 20006

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JOURNALS

" A Model Approach to Acid Rain," Hordijk, *Environment* , v.30, no.2, March, 1988, pp. 16-20.

"100 Trillion Ants Drop Acid," *Discover,* v.8, September, 1987 p.8.

"A Deadly Spell is Hovering Above the Black Forest," Kiester, E. *Smithsonian,* November, 1985, pp. 211-230.

"A Tale of Two Studies," Conuel, *Sanctuary,* v.23, no.9, September, 1984, pp. 10-14.

"Acid Rain: China, United States and a Remote Region," *Science,* June 19, 1987.

"Acid Rain in Europe," *Environment,* v.29, November, 1987, pp. 4-15.

"Acid Rain: What's the Forecast?" *The Science Teacher,* March, 1984, pp. 36-47

"Air: An Atmosphere of Uncertainty," Grove, N. *National Geographic,* v.171, April, 1987, pp 502-537.

"Airborne Chemicals and Forest Health," Woodman, J.N. and E.B. Cowling, *Environment, Science & Technology,* v. 21, 1987, pp 120-128.

"Air Pollution and Forest Health: Three Perspectives," *American Forests,* Nov/Dec, 1987 , p. 60 (4).

" Air Pollution in Europe: International Policy Responses," Sand, *Environment,* v.29, no.10, December, 1987, pp. 16-20.

"Air Pollution by Particles," Shaw, R.W. *Scientific American,* August, 1987, pp. 96-103.

"Antarctic Ozone Depletion Chemistry: Reactions of N2O5 With H2O and HCl on Ice Surfaces," Tolbert, M. A. et al . *Science* v. 240, May 20, 1988. p. 1018 (4).

"Anticipating Climatic Change," Jager, J. *Environment,* v.30 , Sept. 88, pp. 12-15.

"Arctic Trouble: New Holes Found in Ozone Layer Over Pole," *Time,* v.131, May 30, 1988 , p. 58

"Atmospheric Trace Gases: Trends and Distributions Over the Last Decade," *Science,* v. 232, 1986, pp 1623-1624.

"Are We Close to the Road's End?" *Discover,* January, 1986 , pp. 28-50.

"Behind Closed Doors: II. Indoor Air Pollution and Government Policy," Kirsch, L. *Environment,* v.25, April, 1983. pp. 26-39.

"Changes in Stratospheric Ozone," Cicerone, R.J. *Science,* v.237, July 3, 1987, pp. 35-42.

"Chlorofluorocarbons and Stratospheric Ozone,"*Journal of Chemical Education,* v. 64 no. 5, May, 1987, pp. 387-91.

"Clean Air: The Promise is Unfulfilled," Hair, J.D. *National Wildlife,* v. 25, Feb/Mar 1987, p 30.

"Climactic Change: How Vulnerable is Agriculture?" Parry, M. et al. *Environment,* v.27, Jan/Feb, 1985, pp. 4-5, 43.

" Climate Modeling," (Cover), Schneider, S.H. *Scientific American,* V. 256, May, 1987, pp 72-78+.

"Decline of the CFC Empire," Monastersky, R. *Science News,* v.133, April 9, 1988, p. 234 (3).

"Du Pont Risks Phaseout of CFCs," Crawford, M. *Science,* v.240, April 24, 1988, p. 24.

"Economics and the Ambient Ozone Standard," Krupnick, *Resources,* no. 92 Summer, 1988, pp. 9-12.

"Effects of Acid Rain on Freshwater Ecosystems," Schindler, D.W. *Science,* v.239, January 8, 1988, pp. 149-157.

"European Concern about Acid Rain is Growing," *Chemical and Engineering News,* January 28, 1985, pp. 12-18.

"Evidence of Arctic Ozone Destruction," Kerr, R. A. *Science,* v.240, May 17, 1988 , pp. 1144 (2).

"Exchange of Materials Between Terrestrial Ecosystems and the Atmosphere," Mooney, H.A. et al. *Science,* v.238, Nov 13, 1987, pp. 926-932.

" Global Temperature Variations Between 1861 and 1984," Jones, P.D. et al. *Nature* , v. 332, July 31, 1986.

7

JOURNALS

"Greenhouse Effect and Ozone Depletion," *EPA Journal,* December, 1986.

"Greenhouse Warming Still Coming," Kerr,R.A. *Science*, v.232, May 2, 1988, pp. 593-594.

"Has Stratosheric Ozone Started to Disappear?" Kerr,R.A. *Science*, v.237, July 10, 1987, pp. 131-132.

"High Noon for Smog Control," Strait, D.S. and R.E. Ayers. *Environment*, v. 29, Sept. 1987, pp 43-45.

"How Long a Farewell to CFC Production?" Madkerron, C. B. *Chemical Week*, v.142, April 6, 1988, p. 7 (2).

"How Safe is the Air Inside Your Home?" Lipske, M. *National Wildlife*, v.25, April/May, 1987, pp. 34-39.

"Indoor Air Pollution: A Public Health Perspective," Spengler, J.D. and K. Sexton, *Science*, V. 221, July, 1983, pp 9-18.

"Indoor Air Quality Under the Microscope," Eaton, D. *Popular Mechanics*, v.164, August, 1987, pp. 103-106.

"Is the Greenhouse Here?" Kerr, R.A. *Science*, v.239, February 5, 1988, pp. 559-560.

"Life, The Great Chemistry Experiment," Postel, S. *Natural History*, v. 96, April, 1987, pp 41-48.

"Made in the Shade? No Way," (Ancient Ozone Hole), Taubes, G. *Discover*, v. 8, August, 1987, pp 62-71.

"Monitoring European Transboundary Air Pollution," Dovland, *Environment*, v.29, no.10, December, 1987, pp. 10-15

"Montreal Protocol: Controlling Substances That Deplete The Ozone Layer," *Department of State Bulletin*, December, 1987. p. 60 (4).

"Oh, Oh Ozone: New Report on Ozone Layer Depletion, "Fisher,A. *Popular Science*, v.232, June, 1988, p .8 (2)

"On the Trail of Acid Rain," Begley, S. *National Wildlife*, v.25, Feb/Mar, 1987, pp. 6-13.

"Our Fragile Atmosphere: The Greenhouse Effect and Ozone Depletion," *EPA Journal*, v.12 no. 10 , December, 1986.

"Ozone Hole Bodes Ill for the Globe," Kerr, R.A. *Science*, v.241, August, 12, 1988, pp. 785-786

. "Ozone Hole Deeper Than Ever," *Nature*, October 8, 1987. pp.430-434.

"Ozone Layer: Study Finds Alarming Global Losses," Zurer, P.S. *Chemical & Engineering News*, v.66, March 21, 1988. p. 6 (2).

"Policies on Global Warming and Ozone Depletion," Green, B. *Environment*, v.29, April, 1987. p 5+.

"Rattled by Radon? Don't Panic," Cahan, V. *Business Week*, October 10, 1988, p. 154.

"Report Urges Greenhouse Action Now," Kerr, R.A. *Science*, v.241, July 1, 1988 , pp. 23-24.

"Saving the Earth's Ozone," Cleary, P. *Technology Review*, v.9, May-June, 1988, pp. 15 -16.

"Shake or Bake, "(Greenhouse Effect), *The New Republic*, v.199, Sept 12-19, 1988, pp. 5-8.

"Stratospheric Ozone is Decreasing," Kerr, R. A. *Science*, v.239, March 25, 1988, pp. 1489 -1491.

"Studies on Ozone Destruction Expand Beyond Antarctic," Zurer, P.S. *Chemical and Engineering News*, v.66, May 30, 1988 p. 16 (6).

"Taking Shots at Ozone Hole Theories," Kerr, R. A .*Science*, Nov. 14, 1986, pp. 817 (2).

"The Acid Rain Debate," *The Science Teacher*, April, 1984, pp. 50-55.

"The Antarctic Ozone Hole," Stolarski, R. S. *Scientific American*, January, 1988, p. 30 (7).

"The Biggest Chill," Broeker, W.S. *Natural History*, v. 96, October, 1987, pp 74-80+.

JOURNALS

"The Challenge of Acid Rain," *Scientific American,* v.259, August, 1988, pp. 30-38.

"The Earth's Alarm Bells are Ringing,"(Acid Rain), Smart, T. *Business Week,* July, 1988, p. 29.

"The Endangered Ozone Layer," (Cover), Brasseur, G. *Environment,* v. 29, Jan/Feb, 1987, pp 6-11.

"The Greenhouse Revolution: Climates are Changing and So Will Coastlines as Sea Levels Rise," Wolkomir, R. *Oceans,* v.21, April, 1988, p. 16 (7).

"The Greenhouse Theory of Climate Change: A Test by an Inadvertent Global Experiment," Ramanathan, V. *Science,* v.240, April 15, 1988, pp. 293-299.

"The Heat is On," (Cover), Lemonick, M.D. *Time,* v. 130, Oct. 19, 1987, pp. 58-63.

"The Hole Truth," Citron, M. *Discover,* January, 1988, pp. 72-73.

"The Risk From Radon," *Newsweek,* v.112, Sept 26, 1988, p. 69.

"The Silent Summer: Ozone Loss and Global Warming: A Looming Crisis," *Newsweek,* v.107, June 23, 1986, p. 64+.

"Toxic Wind," Brown, M.H. *Discover,* v.8, November. 1987, pp. 42-49.

"Trace Gases: Potential Impacts on Ozone and Temperature," *Environment,* v. 29, Jan/Feb, 1987, p. 40.

"Tracking the Radon Threat," Langone, J. *Time,* v.132, Sept 26, 1988, p. 69.

"Ultraviolet Verdict: A Global Decline in Atmospheric Ozone Appears To Be Real," Beardsley T. A. *Scientific American,* v. 298, May, 1988, p. 26 .

"We Must Halt Global Warming," Hair, J.D. *National Wildlife,* v.26, Aug/Sept 1988 , p. 26.

"What Goes Up Must Come Down," Carpenter, B. *U.S. News & World Report,* v.105, July 25, 1988, pp. 44-45.

"What to do About Radon," Silberner, J. *U.S. News & World Report,* v.105, Sept 26, 1988, pp. 62-63.

"Will There Be A Next Year?" Boyle, R. H. *Reader's Digest* (Canadian), v.132, April, 1988, pp. 9 (5)

"Winds, Pollutants Drive Ozone Hole," Kerr, R.A. *Science,* v.238, Oct 9, 1987, pp. 156-158.

"Entire Issue Devoted to Smoking *Journal of the American Medical Association,* v.225, Feb 28, 1986.

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A Glossary for Carbon Dioxide and Climate, Milleman, Raymond E. ORNL/CDIAC-22 DOE, March, 1988, 33 pages. Environ. Sci. Div. Publication #3067.

A Matter of Degrees: The Potential for Controlling the Greenhouse Effect, Mintzer, Irving M. World Resources Institute, April, 1987, 72 pages. Order #710, $10.00, ISBN 0-915825-27-9.

A Primer on Greenhouse Gases, Wuebbles, Donald J. and Edmonds, J. DOE/NBB-0083 March, 1988, 90 pages.

Acid Rain American Chemical Society, October, 1982, 14 pages. Free Pamphlet.

Acid Rain and Transported Air pollutants,. Office of Technology Assessment, OTA-0-204 June, 1984.

Altering the Earth's Chemistry: Assessing the Risks, Postel, Sandra. Worldwatch Institute , July, 1986, 65 pages, Worldwatch Paper 71,

Chemical Fact Sheets New Jersey Department of Health, CN 368, Trenton, NJ 08625, (609) 984-2202.

Climate Change and Acid Rain, Mac Donald, Gordon J., MITRE Corporation, Nov. 1985, 40 pages.

Climate Change and Environmental Pollution, Oppenheimer, Michael. Environmental Defense Fund October, 1987. 23 pages, Prepared for workshop, Villach, Austria, 28 Sept .- 2 Oct, 1987.

Common Symbols for Chemicals Listed Under Section 313 of the EPCRA, EPA, Available from EPA's Title III Hotline.

Detecting The Climatic Effects of Increasing Carbon Dioxide, MacCracken, M.C., and F.M. Luther, eds., U.S. Department of Energy, 1985, 198 pages. Report DOE/ER-0235

Developing Policies for Responding to Climate Change, Jaeger, J. World Meteorological Org, (UNEP) April, 1988.WMO/TD225.

Explaining Environmental Risk, Sandman. Office of Toxic Substances, U.S. EPA, 1987, 26 pages FREE information on health effects of chemicals.

Our Polluted Environment: A Long-Term Perspective, Speth, James G. World Resources Institute, Fall, 1988, 40 pages. Order # 762, $5.00.

Pollution on Wheels, Walsh, Michael , American Lung Association, 1988. For this and other papers, contact the author at (202)347-2293.

Predicting Climate Change: An Improved Model of Warming Commitment, Mintzer, Irving. World Resources Inst.,Fall, 1988, 60 pages. Order # 757, $10.00, ISBN 0-915825-30-9

Reforesting the Earth, Postel, S. and Heise, Lori. Worldwatch Institute,April, 1988, 65 pages. Worldwatch Paper 83.

Stepping Lightly on the Earth: Everyone's Guide to Toxics in the Home, Greenpeace, 8 pages.

Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances, EPA. 1987,175 pages. FREE from Right-To-Know Hotline.

PAMPHLETS AND PAPERS

The American West's Acid Rain Test, Roth, Philip et al. World Resources Institute, 1985. 60 pages No. 717 , $10.00.

The Changing Atmosphere: Tending the Global Commons, American Chemical Society, A C S Nov. 24, 1986. 50 pages. Reprint from *Chemical & Engineering News-* available for $ 5.

The Greenhouse Effect, Hare, F. Kenneth. 1988, 19pages. Notes for address at World Conf. on the Changing Atmosphere, Toronto, 6/27/88.

The Greenhouse Gases, UNEP/GEMS Environment Library # 1, 1987. 40 pages.

The Prospect of Solving the CO2 Problem through Global Reforestation, Marland, Gregg and Envir. Sc. Div. ORNL DOE/NBB-0082, Feb, 1988, 60 pages.

The Sky Is The Limit: Strategies for Protecting the Ozone Layer, Miller, Alan and Irving Mintzer. World Resources Institute, 1986. 48 pages. Order # 783, $10.00, ISBN 0-915825-17-1.

Title III List of Lists: Consolidated List of Chemicals Subject to Reporting Under Title III. E P A , 1987, 29 pages. FREE from EPA Title III Hotline.

Tropospheric Chemistry, American Chemical Society, Oct. 4, 1982.13 pages.Reprint from Chemical & Engineering News- available for $3.

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BOOKS

American Chemical Society . *Cleaning Our Environment: A Chemical Perspective* Washington, DC:AmericanChemical Society, 1978. If you can get only one book, this should be it.

Bolin, B. and R. B. Cook, ed., *The Major Biogeochemical Cycles and Their Interactions,* Scope 21, New York: John Wiley and Sons, 1983.

Brown, Michael H. *The Toxic Cloud, The Poisoning of America's Air,* New York: Harper and Row, 1987.

Ivanov, M.V. and J.R. Freney, eds. *The Global Biogeochemical Sulfur Cycle,* New York: John Wiley & Sons, 1983.

Kneese, Allen V. *Measuring the Benefits of Clean Air and Water,* Baltimore, MD:Resources for the Future, 1984.

Malone, T.F. and J.G. Roederer, eds, *Global Change,* Cambridge, England :Cambridge University Press, 1985.

Miller, G. Tyler, Jr. *Living in the Environment.,* Belmont, CA: Wadsworth, 1985. . Includes chapter on air pollution.

National Acacemy of Sciences. *Acid Deposition: Long-Term Trends,* Washington, DC: National Academy Press, 1986.

National Clean Air Coalition , *The Clean Air Act, A Briefing Book for Members of Congress* Washington, DC:NCAC. 1985 .

National Research Council, *Changing Climate,* Washington, DC: National Academy Press, 1983.

Office of Technology Assessment. *Acid Rain and Transported Air Pollutants: Implications for Public Policy,* Washington, DC, U.S. Congress, 1984.

Office of Technology Assessment. *The Regional Implications of Transported Air Pollutants: An Assessment of Acidic Deposition and Ozone.* Washington, D.C. U.S. Congress, 1982.

Robin, Warwick, Doos and Jager, eds.,*The Greenhouse Effect, Climate Change and Ecosystems,* New York: John Wiley & Sons, 1986.

Seinfield, J.H. *Air Pollution: Physical and Chemical Fundamentals,* New York: McGraw Hill, 1975.

Smith, William H., *Air Pollution and Forests,* New York: Springer-Verlag, 1981.

Spiro, T.G. and Stigliano, W.M. *Environmental Issues in Chemical Perspective,* Albany, NY: State University of New York, 1980.

Stern A.C., Wohlers, H.C., Bouble, R.W. and Lowrey, W.P. *Fundamentals of Air Pollution,* Orlando: Academic Press, 1984.

Wark, Kenneth, and Cecil F. Warner. *Air Pollution: It's Origin and Control,* 2nd ed., New York: Harper and Row, 1981.

Williamson, Samuel J. *Fundamentals of Air Pollution,* Reading, MA: Addison-Wesley , 1973. Although old, still one of the best basic texts.

MAPS

Detailed maps of U.S. areas sensitive to acidification may be obtained from The National Clean Air Fund, Washington, DC 20003.

or

J.M. Omerick
Corvallis Environmental Research Laboratory
USEPA, Corvallis, OR 97333.

SELECTED BOOKS FOR GRADES 7-12

From list compiled by Gretl Cox of EPA's Headquarters Library

Acid Rain by Kathlyn Gay. New York: F. Watts, 1983.

Acid Rain: A Sourcebook for Young People by Christina Miller, New York: J. Messner, 1986.

Air Pollution Experiments for Junior and Senior High Science Classes by Donald C. Hunter, Pittsburgh: Air Pollution Control Assoc. 1972.

The Air We Live In: Air Pollution, What We Must Do About It by James Marshall, New York: Coward-McCann, 1970.

Clean Air, Clean Water for Tomorrow's World by Reed Millard, New York: J. Messner, 1977.

Dangerous Air by Lucy Kavaler. New York: John Day & Co., 1976.

Going Sour: Science and Politics of Acid Rain by Roy Gould, Cambridge MA: Birkhauser Boston, Inc., 1985.

Industrial Pollution by Eva and Alexander Stwertka, New York: F. Watts, 1981

A Killing Rain: The Global Threat of Acid Precipitation by Thomas Pawlick, San Francisco: Sierra Club Books, 1984

The Long, Long Pollution Crisis by Theodore S. Pettit, New York: Putnam, 1975.

The New York Times Encyclopedic Dictionary Of the Environment by Paul Sarnoff, New York: Quadrangle Books, 1971.

Now or Never: The Fight Against Pollution by Daniel Stephen Halacy, New York : Four Winds Press, 1971.

Pollution: The Air We Breathe by Claire Jones, Minneapolis: Lerner Publications, 1971.

Protecting Our Environment by Grant S. McClellan, New York: H.W. Wilson, 1970.

Troubled Skies, Troubled Waters: The Story of Acid Rain by Jon R. Luoma, New York: Viking, 1984.

We Are The Targets: The Story of Environmental Impact by Harold J. McKenna, New York: Richard Rosen Press, 1980.

The World You Inherit: A Story of Pollution by John Gabriel Navarra, New York: Natural History Press, 1970.

Your Environment: Air Pollution and Weather by Collins M. Henson, Danville, IL: Interstate Printers Publishers, 1971.

(For complete list, write for: **Books for Young People on Environmental Topics,** EPA, January, 1987.)

Asbestos Special

Asbestos Issues
Softek Communications, Inc.
760 Whalers Way
Ste, 100 Building A
Fort Collins, CO 80525
(303) 229-0029
$40 / yr., U.S.
$55 / yr., Can.
$65 / yr., other foreign.

ECON: Environmental Contractor
PO Box F
Braintree, MA 02184
$35 / yr., U.S.
$42 / yr., Can.
Single copies: $3.25
Published monthly by
The Wrecking
and Salvage Journal, Inc.

Asbestos Abatement
Wycoff, Inc.
PO Box 5504
Washington, DC 20016
$30 / yr, members of Asbestos Abatement Council,
$42 / yr., non-members
Sample copy: $4 pre-paid.

Asbestos Waste Management, Guidance: Generation, Transport, Disposal.
EPA/ 530-SW-85-007, May, 1985
Office of Solid Waste, 32 pages.

Guidance for Controlling Asbestos Containing Materials in Buildings.
EPA 560-5-85-024, June, 1985.
Office of Pesticides and Toxic Substances.

MEDIA MATERIALS

Acid Rain
17 min, (grades 6-12), 1984
Surveys damage created by acid precipitation. Includes a laboratory simulation and a discussion of the pH scale.

Rental $ 20 from Syracuse,
1455 East Colvine St.
Syracuse, NY 13244
(800)-223-2409 (outside NY)
(800)-345-6797 (in NY)

Air is Life
Prod. Condor Films.
15 min. (high school to adult)
Examines air from a global perspective and proposes solutions to problems through cooperative international legislation. Includes dialog with politicians and scientists.
Award: Chicago Internat.ional Film Festival.
16mm Sale: $275 Rent: $20
Video $225

Order from:
International Film Bureau
332 S. Michigan Ave.
Chicago, IL 60604
(312)427-4545

Challenges To a Healthy Environment
17 min Sound Filmstrips
Prod. National Geographic, 1986.
A. Hazardous Waste
B. Acid Rain

Order from National Geographic, #30117

Climate, Weather and People
29 min. Video

Hawkhill Associates
Rental, $52; Copy, $80

Hole in the Sky, (NOVA)
58 min VHS, 1987
Documentary of expedition to Antarctica to study ozone levels and decide if depletion is a natural phenomenon or effect of CFCs.

Rental $15, Order #6-00424 from Syracuse. (address above).

Man Builds, Man Destroys
Prod. United Nations Television/ NY State Education Department

A Series of 30 programs, each 30 minutes long and based on the concept that one can aid in correcting the environment.

6. "The Car in the City,"
#11 . "The Air We Breath."
#12. "Only One Earth."
#18. "Traffic or Transit."
#29. "Everyone Talks About It: Effects of Pollutants on Global Weather Patterns.

Rental: $40 @.
Center for Learning Technologies
Media Distribution Network
Rm. C-6, Concourse Level
Cultural Education Center
Albany, NY 12230

National Center for Atmospheric Research
29 min, PBS..
Prod. Creativity with Bill Moyers.

Shows research at NCAR with an emphasis on CO_2.

VHS Rental: $95, Purchase: $200.
Order From: PBS Video
1320 Braddock Place
Alexandria, VA 22314
(1-800) 344-3337

The CFC Story
18 min, 16mm.
Prod. DuPont
Examines the possible effects of chlorofluorocarbons.
Rental: FREE (#12616) from Modern Talking Picture.

To Catch a Cloud: A Thoughtful Look at Acid Rain.
28 min. 16mm or 1/2" VHS
Prod. Alliance for Balanced Environmental Solutions.

Tries to dispel propaganda and rhetoric by providing factual information about the atmosphere and ongoing research.

Rental: FREE from Modern Talking Picture.

EPA's Right to Know Hotline
(800) 535-0202
in DC, 479-2449

SOFTWARE

COMPUTER SOFTWARE

Air Pollution: E.M.E.
Simulation
Grades 7-12
Package consists of a program disk, a back-up disk, Teacher's Guide and student worksheets.

Student is put in the role of an environmental planner who must control carbon monoxide levels in an urban environment. An introduction reviews the health effects of CO, factors affecting CO levels, U.S. standards for CO and causes of thermal inversions. The use of computer models and "worse case" analysis also included. In the experimental mode, the student manipulates variables such as number of vehicles, traffic speed, wind speed and amount of exhaust per vehicle to control the CO levels in "Pollution City." Data may be displayed in tables or graphs on the screen or printed out as tables.

Ratings:
"Exemplary", Lawrence Hall of Science
"Highly Recommended," Micro-SIFT

Apple II, Diskette. $47
TRS-80(Models 1,III, 4) Diskette. $42
IBM PC/PC Jr., Diskette. $52

Hot House Planet: E.M.E.
Simulation
Grades 8-12

Package includes Program disk and Student Work Booklets.

The program (available early 1989) examines the causes and consequences of the "Greenhouse Effect". Students manipulate variables such as world population, fossil fuel use and release of trace gases to see their effect on temperatures and sea level. Volcanic activity and solar radiation may also be varied as illustrations of the influence of factors beyond human control.

An option, based on data supplied by NASA/ Goddard Institute for Space Studies, allows students to study predictions for changes in global temperature and sea level for each decade up to the year 2100.

Apple II diskette, $70.

Order from E.M.E
Old Mill Plain Road
P.O. Box 2805
Danbury, CN 06813-2805

Acid Rain Foundation Materials

Acid Rain Science Projects
Grades 5-12, $9.95

The Air Around Us: An Air Pollution Primer.
$ 8.95

Bibliography - Acid Rain
$8.00

Bibliography - Air Pollutants \ Forests
$ 8.00

Curriculum: Grades 6-12
Single Sections: $12.95 @
Life Science, Biology
Earth Science
Physical Sci., Chemistry
Social Sciences
All four packets + Information, $49.95

Resource Directory, 1986
$10.00

Speaker's Bureau
$8.00

For more information on these and other materials, contact ARF at (919) 828-9443

CHLOROFLUOROCARBONS: DOUBLE INSULT TO OUR AIR QUALITY

by John L. Roeder

In the troposphere around us they are harmless. They are the working fluids in our refrigerators and air conditioners, and until 1978 they were the aerosol propellants in our spray cans. They are known as chlorofluorocarbons — CFC's for short.

In the stratosphere above us they are harmful. After lingering in the troposphere about five years, their molecules move into the stratosphere, where solar ultraviolet light frees chlorine atoms to destroy molecules of ozone, which are in equilibrium with atomic and diatomic oxygen. Then the two following reactions occur:

$$Cl + O_3 \longrightarrow ClO + O_2$$

$$ClO + O \longrightarrow Cl + O_2.$$

These reactions have the net effect of converting an ozone molecules (O_3) and oxygen atom into two diatomic oxygen molecues (O_2) while leaving the original chlorine atom free to repeat the same "crime" over and over again, until it is sequestered in molecules of hydrogen chloride (HCl) or chlorine nitrate ($ClONO_2$).

The "crime" wrought thereby is the depletion of a shield of ozone which has absorbed solar ultraviolet light in the stratosphere and protected us from it in the troposphere. Without this protection, solar ultraviolet light could penetrate the troposphere and free chlorine atoms from CFC's in our immediate environment. More seriously, it would expose all living species to the risk of molecular dissociation, some of it cancerous: a 2% ozone decrease is expected to increase skin cancers by 10%. This would endanger humans not only by affecting them directly but also by affecting their entire food chain.

Because chlorine atoms have been implicated in the depletion of the stratosphere ozone layer, by amounts approaching 50% in the Antarctic as spring comes to that region, more than a score of nations signed the Montreal Protocol in September 1987. This agreement would freeze CFC production at 1986 levels by 1989 and cut this production in half by 1999. Yet a year later the Administrator of the U. S. Environmental Protection Agency (EPA), in an administration not known for an outstanding environmental record, said that this was not enough. EPA Administrator Lee Thomas called for the complete phasing out of production of CFC's along with that of another increasingly-used chlorinated hydrocarbon, methyl chloroform. The originator of CFC's, E. I. duPont de Nemours & Company, has now developed an alternative refrigerant and has agreed to phase our CFC's by 1999. Meanwhile, only 8 nations have ratified the Montreal Protocol of the 11 required for it to go into effect, and other U.S. manufacturers need to be convinced to follow DuPont's lead.

There is a second reason to phase out CFC's as well. In addition to their depletion of the ozone layer, CFC's are also culprits in enhancing the greenhouse effect. This effect, which threatens to produce unprecedented changes in earth's climate if left unchecked, has been attributed primarily to increased atmospheric carbon dioxide from fossil fuel emissions and deforestation. Yet, other gases in smaller concentrations are increasing the effect as much as is carbon dioxide, and among these gases are CFC's. In fact, one molecule of CFC-11 ($CFCl_3$) and one molecule of CFC-12 (CF_2Cl_2) produce the same greenhouse effect as ten thousand molecules of carbon dioxide.

Chlorofluorocarbons, once a boon to humanity, are now recognized as a bane. The replacement developed by DuPont promises to be a boon. It remains to be seen whether it will be a bane as well.

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HOW TO COPE WITH CLIMATE CHANGE

by

Irma S. Jarcho

Officials, scientists, and environmentalists from forty eight countries met at a June conference in Toronto to discuss the implications of climate change. The conference was sponsored by Canada, UNEP and The World Metereological Organization.

A consensus emerged for a global convention on atmospheric protection by 1992 similar to the one which negotiated the international ozone protection protocol.

UNEP - commissioned scientists had released on June 6 a study of policies needed to cope with climate change. They urged:

1. Ratification of ozone protocol
2. Reduction of burning of fossil fuels that emit CO2
3. Promotion of energy efficiency and alternate sources of energy
4. Slowing of deforestation— which now amounts to 22 million acres a year
5. Limitation of other greenhouse gases
6. Identification of areas particularly vulnerable to sea-level rise
7. Development of policy options for dealing with its consequences

A few years ago these recommendations would have been dismissed as part of a ridiculous fantasy. After the summer we have just experienced , they seem less absurd. The UNEP scientists went on to prognosticate on the World in 2030

"Alaskan fish catches are up thanks to warmer climates. In the Great Plains dust bowl some farmers are trying grains engineered espeacially for deserts/ Other farmers have moved to the Canadian interior. Lake Michigan is evaporating while Louisiana wetlands are submerged and lost to the sea. To keep their heads above water, New Yorkers are building levees during a summer of 90o days..."

AIR QUALITY OF THE PAST

by

John L. Roeder

"On a clear day one might have been able to see across the local pool or arm of ocean to its opposite volcanic shore, and perhaps to granitic uplands beyond. Not many days would have been that clear, however, during much of the time clouds of steam and dust from submarine eruption or from lavas entering the sea would have kept the atmospher hazy. To this haze, from time to time, a variety of sulfurous, chloridic, and nitrous volcanic gases would have been added, dwarfing the volumes of today's largest smelters and creating unparalleled and unalleviated conditions of smog and acid rain. An atmosphere of CO_2, H_2O, CO, N, and noxious trace gases would simultaneously have kept Earth's surface warm and its water fluid under the faint early Sun." This is how the air quality of more than three billion years ago is reported by Preston Cloud on page 144 of his recent book, *Oasis in Space* (Norton, 1988). Concerning the required concentration of greenhouse gases, Cloud elsewhere (p. 124) notes that "it as been calculated that a probable 100 times the present concentration of carbon dioxide could have provided a surface temperature of about 11°C." By the time another billion years had passed, the development of anaerobic autotrophs (hailed by Cloud as "the first agricultural revolution") reduced this concentration of carbon dioxide and introduced the first significant concentration of free molecular oxygen. One immediate consequence was reduced greenhouse warming and the first ice age.

EPA MATERIALS

Radon:

A Citizens Guide to Radon: What It Is and What to Do About It..
OPA-86-004, August, 1986. 13 pages.

Removal of Radon from Household Water.
OPA-87-001, Sept., 1987. 8 pages.

Radon Reduction Methods: A Homeowner's Guide.
(2nd ed.) OPA-87-010, Sept., 1987. 22 pages.

Interim Indoor Radon and Radon Decay Product Measurement Protocols
EPA 520-1-86-04, April, 1986
Office of Radiation Programs

Interim Protocols for Screening & Follow-up Radon and Radon Decay Products Measurements, May, 1987
Office of Radiation Programs

Radon / Radon Progeny Measurement Proficiency Program (Cumulative Proficiency Report), Sept., 1987.
Office of Radiation Programs

EERF Standard Operating Procedures for Rn^{222} Measurement Using Charcoal Canisters.
EPA 520-5-87-005, June, 1987
Eastern Env. Radiation Facility
1890 Federal Drive
Montgomery, AL 36109

Fact Sheets: Indoor Air Facts.

#1. "EPA and Indoor Air Quality." June, 1987.

#2. "Indoor Air Quality Implement Plan." June, 1987.

#3. "Ventilation and Air Quality in Offices."

A REPORT ON A WORK IN PROGRESS from The Greenhouse Gas-ette

An Educator's Guide on Global Climate Change is being prepared. Lawrence Berkeley's Center for Science and Engineering Education has agreed to publish a 30-40 page booklet. An announcement on its availability will be printed in the next issue of the magazine of the Climate Protection Institute.

The guide will contain science background material and suggestions for classroom activities. There will be a section on the social and economic issues related to global warming. For further information contact Richard Golden of CPI.

WORLDWATCH PAPERS

Energy and Architecture:The Solar and Conservation Potential by Christopher Flavin. # 40.

Wind Power: A Turning Point by Christopher Flavin. #45.

Six Steps to a Sustainable Society by Lester Brown and Pamela Shaw. # 48.

Air Pollution, Acid Rain, and the Future of Forests by Sandra Postel. #58.

Electricity's Future: The Shift to Efficiency and Small Scale Power by Christopher Flavin. #61

World Oil: Coping with the Dangers of Success by Christopher Flavin. #66

Renewable Energy: Today's Contribution, Tomorrow's Promise by Cynthia Pollack Shea. #81

Building on Success: The Age of Energy Efficiency by Christopher Flavin and Alan B. Durning. #82

Reforesting the Earth by Sandra Postel and Lori Heise. #83.

Rethinking the Role of the Automobile by Michael Renner. #84

Order from Worldwatch Inst.
1776 Massachusetts Ave., NW
Washington, DC 20036